

Supplementary Material

Table 1. Selected studies on NH₃ loss of urea and NBPT-treated urea (Urea+NBPT). Loss reduction by treating urea with NBPT in comparison to untreated urea was calculated as [1-(Total loss_{urea+NBPT}/Total loss_{urea})]*100

Reference	Urea	Urea+NBPT	Loss reduction	Environment
Total NH ₃ loss (%)				%
Abalos et al. [1]	6.7	2.8	57.8	Field
Antisari et al. [2]	52.0	39.9	23.3	Laboratory
Antisari et al. [2]	52.0	33.3	36.0	Laboratory
Antisari et al. [2]	52.0	30.3	41.8	Laboratory
Antisari et al. [2]	60.6	57.8	4.5	Laboratory
Antisari et al. [2]	60.6	54.3	10.5	Laboratory
Antisari et al. [2]	60.6	50.4	16.8	Laboratory
Antisari et al. [2]	58.8	45.3	23.0	Laboratory
Antisari et al. [2]	58.8	38.9	33.8	Laboratory
Antisari et al. [2]	58.8	22.6	61.5	Laboratory
Barth [3]	23.1	10.2	56.1	Field
Barth [3]	18.5	9.3	49.8	Field
Barth [3]	28.1	6.1	78.3	Laboratory
Cancellier et al. [4]	31.2	25.5	18.3	Field
Cantarella et al. [5]	25.5	14.7	42.4	Field
Cantarella et al. [5]	11.0	7.0	36.4	Field
Carmona et al. [6]	55.5	28.9	47.9	Laboratory
Carmona et al. [6]	55.5	32.9	40.7	Laboratory
Carmona et al. [6]	55.5	47.8	13.9	Laboratory
Carmona et al. [6]	49.4	11.2	77.3	Laboratory
Carmona et al. [6]	49.4	14.6	70.4	Laboratory
Carmona et al. [6]	49.4	23.5	52.4	Laboratory
Carmona et al. [6]	42.3	4.3	89.8	Laboratory
Carmona et al. [6]	42.3	11.7	72.3	Laboratory
Carmona et al. [6]	42.3	16.8	60.3	Laboratory
Carmona et al. [6]	49.4	11.2	77.3	Laboratory
Carmona et al. [6]	49.4	14.6	70.4	Laboratory

Reference	Urea	Urea+NBPT	Loss reduction	Environment
	Total NH ₃ loss (%)			%
Carmona et al. [6]	49.4	23.5	52.4	Laboratory
Carmona et al. [6]	46.5	4.9	89.5	Laboratory
Carmona et al. [6]	46.5	8.1	82.6	Laboratory
Carmona et al. [6]	46.5	20.6	55.7	Laboratory
Carmona et al. [6]	71.4	8.3	88.4	Laboratory
Carmona et al. [6]	71.4	11.2	84.3	Laboratory
Carmona et al. [6]	71.4	27.4	61.6	Laboratory
Carmona et al. [6]	64.4	9.6	85.1	Laboratory
Carmona et al. [6]	64.4	12.2	81.1	Laboratory
Carmona et al. [6]	64.4	39.0	39.4	Laboratory
Carmona et al. [6]	52.1	5.9	88.6	Laboratory
Carmona et al. [6]	52.1	8.9	82.9	Laboratory
Carmona et al. [6]	52.1	14.7	71.8	Laboratory
Carmona et al. [6]	52.1	24.2	53.5	Laboratory
Carmona et al. [6]	52.1	32.3	38.0	Laboratory
Christianson et al. [7]	47.0	9.3	80.2	Laboratory
Christianson et al. [7]	47.0	27.6	41.2	Laboratory
Contin [8]	7.2	1.6	77.9	Field
Contin [8]	25.1	21.3	15.1	Field
Dawar et al. [9]	21.9	7.4	66.1	Field
Dillon et al. [10]	20.1	4.1	79.8	Field
Engel et al. [11]	30.8	3.5	88.8	Field
Engel et al. [11]	35.1	16.8	52.0	Field
Engel et al. [11]	39.0	17.0	56.3	Field
Engel et al. [11]	15.9	5.1	67.9	Field
Engel et al. [11]	37.2	7.0	81.3	Field
Ferraris et al. [12]	12.3	5.7	54.1	Field
Ferraris et al. [12]	15.8	3.9	75.3	Field
Fontanetto et al. [13]	48.2	8.7	82.0	Field
Fontanetto et al. [13]	57.0	11.3	80.3	Field
Fontoura et al. [14]	1.3	1.4	-7.7	Field
Fontoura et al. [14]	25.4	10.7	57.9	Field
Fontoura et al. [14]	20.1	11.7	41.8	Field
Fontoura et al. [14]	3.0	2.5	16.7	Field
Fontoura et al. [14]	12.5	6.6	47.2	Field
Frame et al. [15]	37.1	25.0	32.5	Laboratory

Reference	Urea	Urea+NBPT	Loss reduction	Environment
	Total NH ₃ loss (%)			%
Frame et al. [15]	33.7	17.6	47.7	Laboratory
Frame et al. [15]	37.0	24.9	32.6	Laboratory
Frame et al. [15]	37.2	21.4	42.6	Laboratory
Frame et al. [15]	35.6	25.5	28.5	Laboratory
Frame et al. [15]	35.6	23.7	33.5	Laboratory
Frame et al. [15]	35.6	23.5	34.0	Laboratory
Frame et al. [15]	35.6	22.0	38.2	Laboratory
Frame et al. [15]	35.6	20.0	44.0	Laboratory
Frame et al. [15]	35.1	24.0	31.5	Laboratory
Frame et al. [15]	35.1	20.0	42.9	Laboratory
Frame et al. [15]	35.1	19.3	45.0	Laboratory
Frame et al. [15]	35.1	20.0	43.2	Laboratory
Frame et al. [15]	35.1	21.9	37.7	Laboratory
Frame et al. [16]	40.1	20.6	48.6	Laboratory
Frame et al. [16]	40.1	27.9	30.4	Laboratory
Frame et al. [16]	44.5	30.0	32.6	Laboratory
Frame et al. [16]	44.5	25.0	43.8	Laboratory
Frame et al. [16]	38.2	8.5	77.7	Laboratory
Frame et al. [16]	38.2	10.1	73.6	Laboratory
Franzen et al. [17])	56.9	18.3	67.8	Laboratory
Gill et al. [18]	7.1	1.3	82.4	Laboratory
Gill et al. [18]	7.1	0.7	90.2	Laboratory
Gill et al. [18]	10.7	8.2	23.8	Laboratory
Gill et al. [18]	10.7	8.0	25.6	Laboratory
Gill et al. [18]	10.7	6.4	39.9	Laboratory
Gill et al. [18]	11.7	9.6	18.1	Laboratory
Gill et al. [18]	11.7	8.6	27.0	Laboratory
Gill et al. [18]	11.7	7.2	38.9	Laboratory
Gioacchini et al. [19]	4.3	2.2	48.9	Field
Gioacchini et al. [19]	10.9	1.2	88.6	Field
Grant et al [20]	38.0	2.2	94.3	Field
Grant et al [20]	83.0	11.6	86.0	Field
Liu et al. [21]	1.59	1.04	34.6	Field
Massey et al. [22]	14.3	3.2	77.6	Field
Massey et al. [22]	16.9	3.0	82.2	Field
Mira et al. [23]	13.7	10.9	20.4	Field

Reference	Urea	Urea+NBPT	Loss reduction	Environment
	Total NH ₃ loss (%)			%
Mira et al. [23]	13.7	7.5	45.3	Field
Mira et al. [23]	13.7	7.4	46.0	Field
Mira et al. [23]	13.7	7.2	47.4	Field
Mira et al. [23]	32.7	24.7	24.5	Field
Mira et al. [23]	32.7	28.0	14.4	Field
Mira et al. [23]	32.7	23.2	29.1	Field
Mira et al. [23]	19.3	11.6	39.9	Field
Mira et al. [23]	19.3	11	43.0	Field
Mira et al. [23]	19.3	8.4	56.5	Field
Mira et al. [23]	19.3	7.5	61.1	Field
Mira et al. [23]	29.7	17.5	41.1	Field
Mira et al. [23]	29.7	11.5	61.3	Field
Mira et al. [23]	29.7	10.8	63.6	Field
Mira et al. [23]	29.7	9.5	68.0	Field
Mira et al. [23]	19.9	17.7	11.1	Field
Mira et al. [23]	19.9	15.2	23.6	Field
Mira et al. [23]	19.9	13.3	33.2	Field
Mira et al. [23]	19.9	11.2	43.7	Field
Norman et al. [24]	25.6	12.0	53.1	Field
Norman et al. [24]	21.2	8.2	61.3	Field
Otto et al. [25]	20.4	13.8	32.2	Field
Pereira et al. [26]	65.0	35.0	46.2	Field
Rawluk et al [27]	22.0	5.6	74.4	Field
Rawluk et al [27]	22.0	4.4	80.2	Field
Rawluk et al [27]	22.0	4.0	81.8	Field
Rawluk et al [27]	26.5	7.3	72.7	Field
Rawluk et al [27]	26.5	4.8	82.0	Field
Rawluk et al [27]	26.5	4.0	84.9	Field
Rawluk et al [27]	20.4	5.3	74.1	Field
Rawluk et al [27]	20.4	3.8	81.3	Field
Rawluk et al [27]	20.4	2.6	87.5	Field
Rawluk et al [27]	50.0	36.3	27.5	Field
Rawluk et al [27]	50.0	30.2	39.6	Field
Rawluk et al [27]	50.0	32.2	35.5	Field
Rochette et al. [28]	8.0	3.6	54.6	Field
San Francisco et al [29]	41.3	6.5	84.3	Laboratory

Reference	Urea	Urea+NBPT	Loss reduction	Environment
Total NH ₃ loss (%)			%	
San Francisco et al [29]	28.1	13.0	53.9	Laboratory
Sanz-Cobena et al. [30]	10.3	6.3	38.8	Field
Sanz-Cobena et al. [31]	33.0	7.5	77.2	Field
Sanz-Cobena et al. [31]	10.4	3.1	70.2	Field
Sanz-Cobena et al. [31]	8.2	10.2	-24.6	Field
Sanz-Cobena et al. [31]	26.1	1.1	95.8	Field
Sanz-Cobena et al. [31]	3.3	2.2	33.6	Field
Sanz-Cobena et al. [31]	29.3	7.4	74.9	Field
Scivittaro et al. [32]	21.9	2.6	88.1	Field
Scivittaro et al. [32]	15.0	2.5	83.3	Field
Singh et al. [33]	4.9	2.9	41.3	Laboratory
Soares et al. [34]	28.0	6.0	78.6	Laboratory
Soares et al. [34]	37.0	17.0	54.1	Laboratory
Suter et al. [35]	30.0	9.3	69.2	Field
Suter et al. [35]	1.9	1.2	37.3	Field
Tasca et al. [36]	15.0	4.0	73.3	Laboratory
Tasca et al. [36]	28.0	15.0	46.4	Laboratory
Tasca et al. [36]	22.0	13.5	38.6	Laboratory
Tian et al. [37]	1.5	0.7	53.0	Field
Tian et al. [37]	1.6	0.6	62.7	Field
Turner et al. [38]	9.5	1.0	89.5	Field
Viero [39]	12.4	5.9	52.4	Field
Viero [39]	14.6	8.9	39.2	Field
Viero [39]	4.1	4.5	-7.9	Field
Watson et al. [40]	8.1	1.9	76.0	Field
Watson et al. [41]	38.7	31.3	19.0	Laboratory
Watson et al. [41]	38.7	12.8	66.9	Laboratory
Watson et al. [41]	38.7	4.0	89.6	Laboratory
Watson et al. [42]	13.5	5.2	61.5	Laboratory
Watson et al. [42]	13.5	3.9	71.1	Laboratory
Watson et al. [42]	13.5	3.3	75.6	Laboratory
Watson et al. [42]	13.5	2.6	80.7	Laboratory
Watson et al. [42]	13.5	2.7	80.0	Laboratory
Zaman et al. [43]	5.1	2.8	45.0	Field
Zerpa et al. [44]	13.7	9.3	32.0	Field
Zerpa et al. [44]	8.2	6.5	20.7	Field

Reference	Urea	Urea+NBPT	Loss reduction	Environment
	Total NH ₃ loss (%)			%
Zerpa et al. [44]	16.8	13.6	19.2	Field
Zerpa et al. [44]	28.3	6.5	77.2	Laboratory
Zerpa et al. [44]	17.2	14.0	18.3	Laboratory
Zerpa et al. [44]	12.3	12.0	2.5	Laboratory
Zhengping et al. [45]	18.8	3.0	84.0	Laboratory
Zhengping et al. [45]	40.0	19.6	51.1	Laboratory

Table 2. Selected studies on crop yield obtained by urea or NBPT-treated urea (Urea+NBPT). Yield increase by treating urea with NBPT in comparison to untreated urea was calculated as $[(\text{yield}_{\text{urea+NBPT}}/\text{yield}_{\text{urea}}) * 100] - 100$

Reference	Urea	Urea+NBPT	Yield increase	Crop
	Yield (Mg ha ⁻¹)		%	
Dawar et al. [9]	3.4	4.0	16.4	Pasture (Ryegrass/White clover)
Watson et al. [40]	3.0	3.3	8.8	Pasture (Ryegrass)
Singh et al. [33]	1.9	2.3	19.6	Pasture (Ryegrass/White clover)
Suter et al. [35]	0.7	0.6	-9.9	Pasture (Ryegrass)
Suter et al. [35]	2.0	2.0	-2.4	Pasture (Ryegrass)
Zaman and Blennerhassett [46]	10.4	11.5	10.0	Pasture (Ryegrass/White clover)
Zaman and Blennerhassett [46]	11.0	12.1	10.6	Pasture (Ryegrass/White clover)
Zaman and Blennerhassett [46]	10.4	11.5	10.5	Pasture (Ryegrass/White clover)
Zaman and Blennerhassett [46]	11.2	11.9	6.2	Pasture (Ryegrass/White clover)
Connell et al. [47]	19.4	21.6	11.5	Pasture (Cynodon dactylon)
Connell et al. [47]	9.5	10.0	4.9	Pasture (Cynodon dactylon)
Connell et al. [47]	16.8	19.6	17.2	Pasture (Cynodon dactylon)
Connell et al. [47]	12.0	12.8	6.5	Pasture (Cynodon dactylon)
Cunha et al. [48]	2.9	3.1	6.1	Bean
Cunha et al. [48]	3.6	3.8	6.1	Bean
Cunha et al. [48]	3.7	3.8	3.4	Bean
Abalos et al. [1]	6.4	6.8	6.3	Barley (biomass)
Abalos et al. [1]	3.5	3.7	5.6	Barley (grain)
Cancellier et al. [4]	10.7	10.7	0.0	Corn
Cancellier et al. [4]	11.3	11.3	0.0	Corn
Cancellier et al. [4]	11.7	11.7	0.0	Corn
Cancellier et al. [4]	12.0	12.0	0.0	Corn
Ferraris et al. [12]	8.4	8.4	0.2	Corn
Ferraris et al. [12]	8.2	8.6	4.3	Corn
Fontanetto et al. [13]	8.1	9.1	12.5	Corn

Reference	Urea	Urea+NBPT	Yield increase	Crop
Yield (Mg ha^{-1})				
Fontanetto et al. [13]	10.4	11.6	10.9	Corn
Fontoura et al. [14]	14.0	14.5	3.6	Corn
Pereira et al. [26]	7.1	7.5	6.6	Corn
Dawar et al. [49]	5.3	6.4	19.1	Corn
Silva et al. [50]	11.5	10.7	-6.4	Corn
Silva et al. [50]	11.6	11.6	0.4	Corn
Silva et al. [50]	11.9	12.5	5.7	Corn
Silva et al. [50]	12.3	13.4	9.2	Corn
Sanz-Cobena et al. [51]	13.4	14.5	7.9	Corn
Sanz-Cobena et al. [51]	10.7	10.3	-3.5	Corn
Drury et al. [52]	9.6	9.9	3.3	Corn
Drury et al. [52]	12.0	12.5	4.2	Corn
Dillon et al. [10]	9.0	9.5	6.1	Rice
Dillon et al. [10]	8.4	8.5	0.3	Rice
Dillon et al. [10]	9.3	9.4	1.6	Rice
Norman et al. [24]	5.4	5.5	1.7	Rice
Norman et al. [24]	4.6	5.5	19.7	Rice
Norman et al. [24]	3.6	5.7	56.1	Rice
Norman et al. [24]	7.3	7.3	-1.0	Rice
Norman et al. [24]	6.5	7.4	14.5	Rice
Norman et al. [24]	5.7	7.2	26.0	Rice
Norman et al. [24]	7.5	7.7	3.1	Rice
Norman et al. [24]	6.7	7.9	18.3	Rice
Norman et al. [24]	6.4	7.5	16.0	Rice
Norman et al. [24]	9.4	9.5	0.2	Rice
Norman et al. [24]	8.1	9.2	13.8	Rice
Norman et al. [24]	7.8	8.8	13.9	Rice
Scivittaro et al. [32]	8.0	8.7	9.0	Rice
Scivittaro et al. [32]	8.8	8.9	1.3	Rice
Scivittaro et al. [32]	9.1	9.2	1.2	Rice
Grohs et al. [53]	10.3	9.8	-5.0	Rice
Grohs et al. [53]	10.1	9.9	-2.4	Rice
Grohs et al. [53]	11.0	10.2	-7.7	Rice
Grohs et al. [53]	9.8	10.5	7.2	Rice
Marchesan et al. [54]	9.6	9.6	0.0	Rice

Reference	Urea	Urea+NBPT	Yield increase	Crop
	Yield (Mg ha ⁻¹)			%
Marchesan et al. [54]	9.6	9.6	0.0	Rice
Marchesan et al. [54]	10.2	10.2	0.0	Rice
Marchesan et al. [54]	9.6	10.4	8.3	Rice
Marchesan et al. [54]	10.0	10.4	4.0	Rice
Marchesan et al. [54]	8.2	9.4	14.6	Rice
Marchesan et al. [54]	10.2	10.2	0.0	Rice
Marchesan et al. [54]	9.4	9.4	0.0	Rice
Liu et al. [55]	7.1	8.1	12.7	Rice
Liu et al. [55]	7.1	8.2	14.4	Rice
Liu et al. [55]	7.1	8.6	20.0	Rice
Liu et al. [55]	7.1	8.3	16.8	Rice
Liu et al. [55]	7.1	8.3	16.4	Rice
Liu et al. [55]	9.7	9.8	0.8	Rice
Liu et al. [55]	9.7	10.1	4.1	Rice
Liu et al. [55]	9.7	10.5	7.9	Rice
Liu et al. [55]	9.7	9.6	-1.7	Rice
Liu et al. [55]	9.7	8.9	-8.8	Rice
Dawar et al. [56]	5.4	6.2	15.4	Wheat
Espindula et al. [57]	2.7	3.1	13.3	Wheat
Espindula et al. [57]	3.6	3.9	8.3	Wheat
Espindula et al. [57]	3.8	4.3	13.5	Wheat
Espindula et al. [57]	4.1	4.7	15.4	Wheat
Espindula et al. [57]	4.2	4.1	-4.4	Wheat
Kaneko et al. [58]	4.1	4.3	4.3	Cotton
Kaneko et al. [58]	4.1	4.1	-0.7	Cotton
Barth [3]	59.5	61.7	3.7	Sugarcane
Barth [3]	65.3	63.2	-3.2	Sugarcane
Barth [3]	67.9	68.1	0.3	Sugarcane
Barth [3]	56.2	60.9	8.4	Sugarcane
Barth [3]	64.5	63.4	-1.7	Sugarcane
Barth [3]	69.5	68.2	-1.9	Sugarcane
Contin [8]	109.0	103.0	-5.5	Sugarcane
Contin [8]	113.0	104.0	-8.0	Sugarcane
Contin [8]	112.0	110.0	-1.8	Sugarcane
Moreira [59]	113.8	118.9	4.5	Sugarcane

Reference	Urea	Urea+NBPT	Yield increase	Crop
	Yield (Mg ha^{-1})		%	
Moreira [59]	129.1	123.8	-4.1	Sugarcane

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